Status of E391a
Search for $K_L \rightarrow p^0 \nu\bar{\nu}$ decay

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@ 32nd ICHEP 19th August 2004 Beijing

E391a Collaboration

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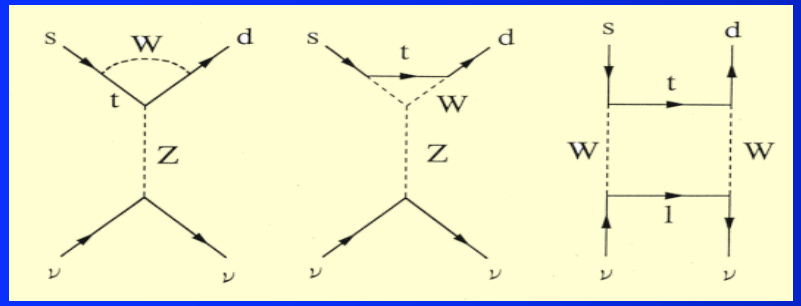
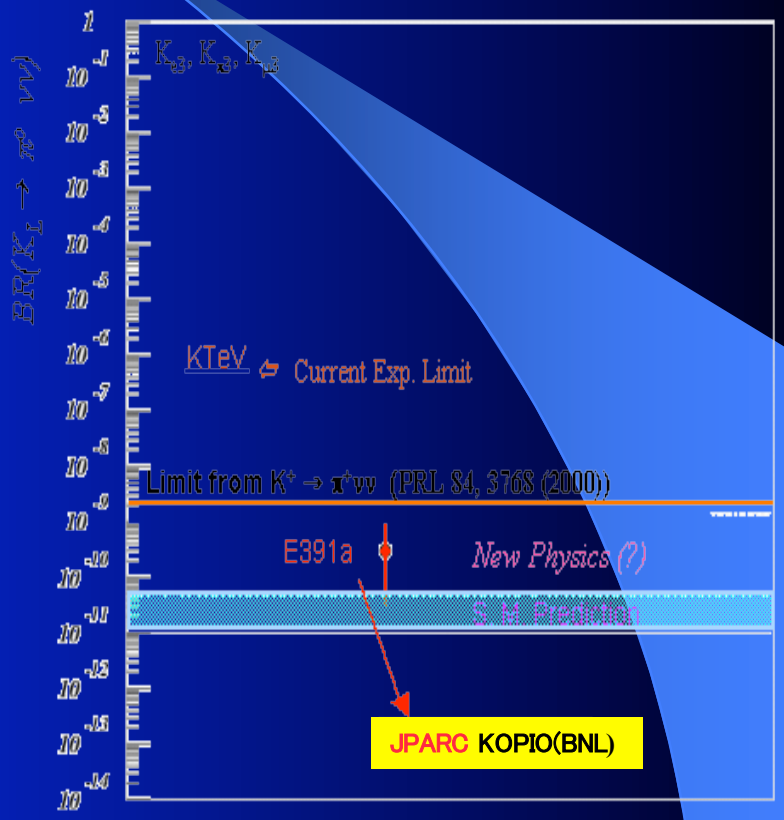
Introduction

- Searching for $K_L \rightarrow p^0 n n$ decay
  - Flavor Changing Neutral Current
  - Direct CP violation ($\Delta s = 1$)

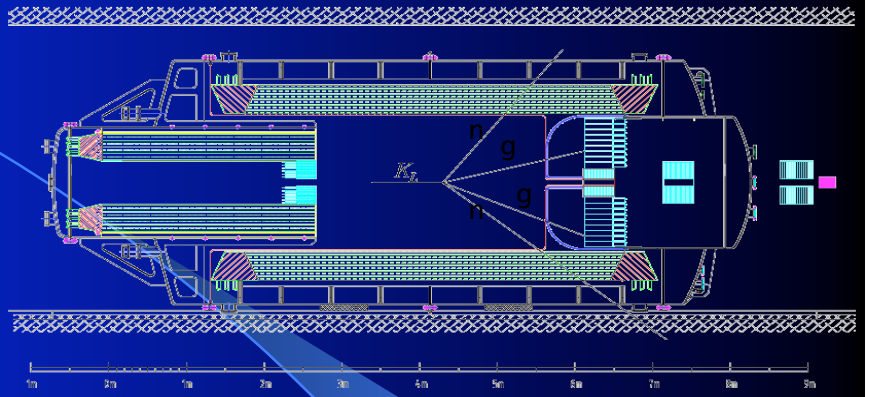


  - Clean measurement of $\mathrm{Im}(V_{td}) \sim \eta$
- First dedicate experiment
- Step-by-step approach

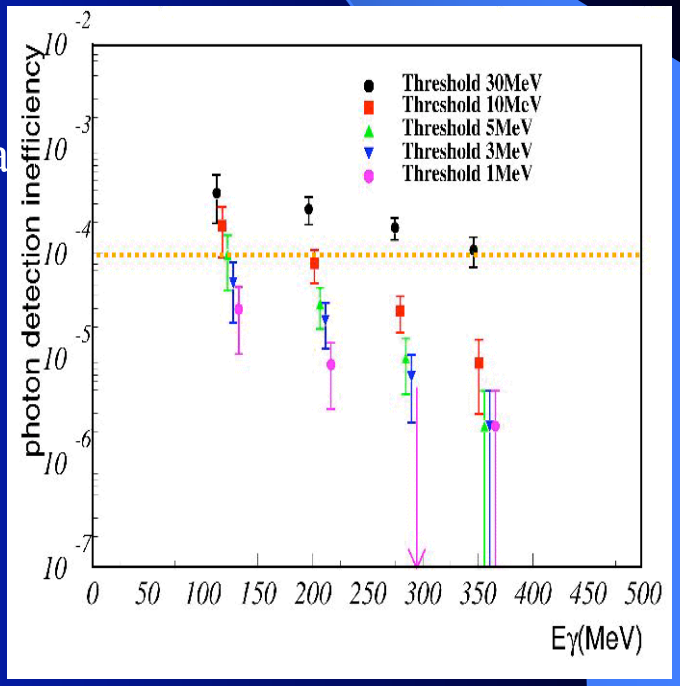
  E391a($O(10^{-10})$) → J-PARC($O(10^{-13})$)



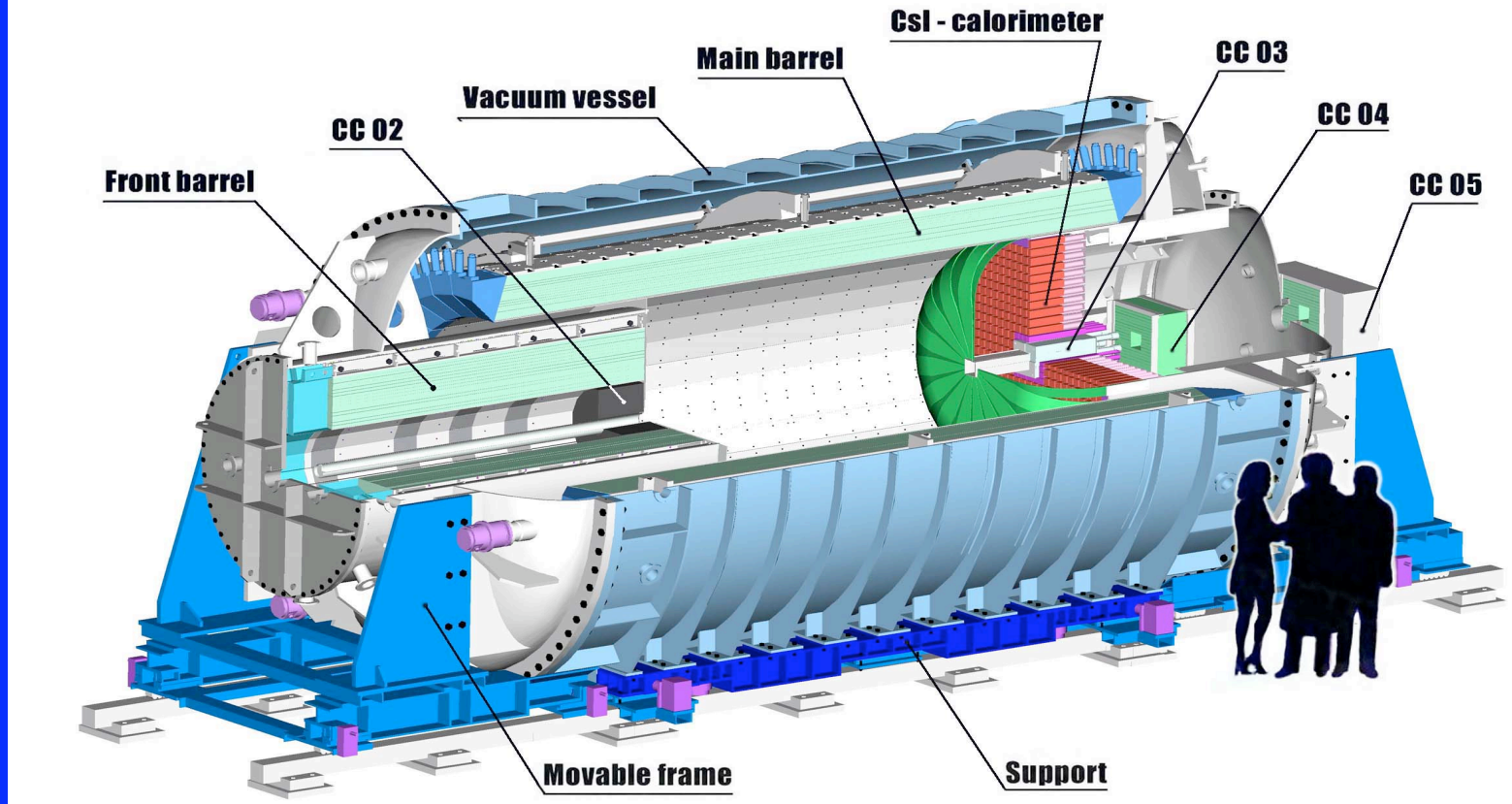
Detection principle



- p^0 with high P_T
- Pencil beam
  - Narrow beam – P_T resolution
    single p^0 production (from halo neutron)
  - Low energy – free from hyperon decays
- Detector system in vacuum
  - Minimize materials between decay region a
- Perfect Veto system
  - Hermetic veto counters including beamline
  - Double decay chamber
    - Reject K_L decay in front of fiducial region
  - High detection efficiency
    - Low detection threshold



E391a apparatus



History

- Dec.1996: conditionally approved
- Mar.1999: constructed the beam line
- July 2001: approved
- Oct. 2002: engineering run
- Jan. 2004: finish detector assembling
- 18 Feb. –June 30 2004: Data taking

Data taking

12 GeV incident protons

2.2 X 10^{12}/spill at target

2s spill length

4s repetition

K_L Yield in front of detector

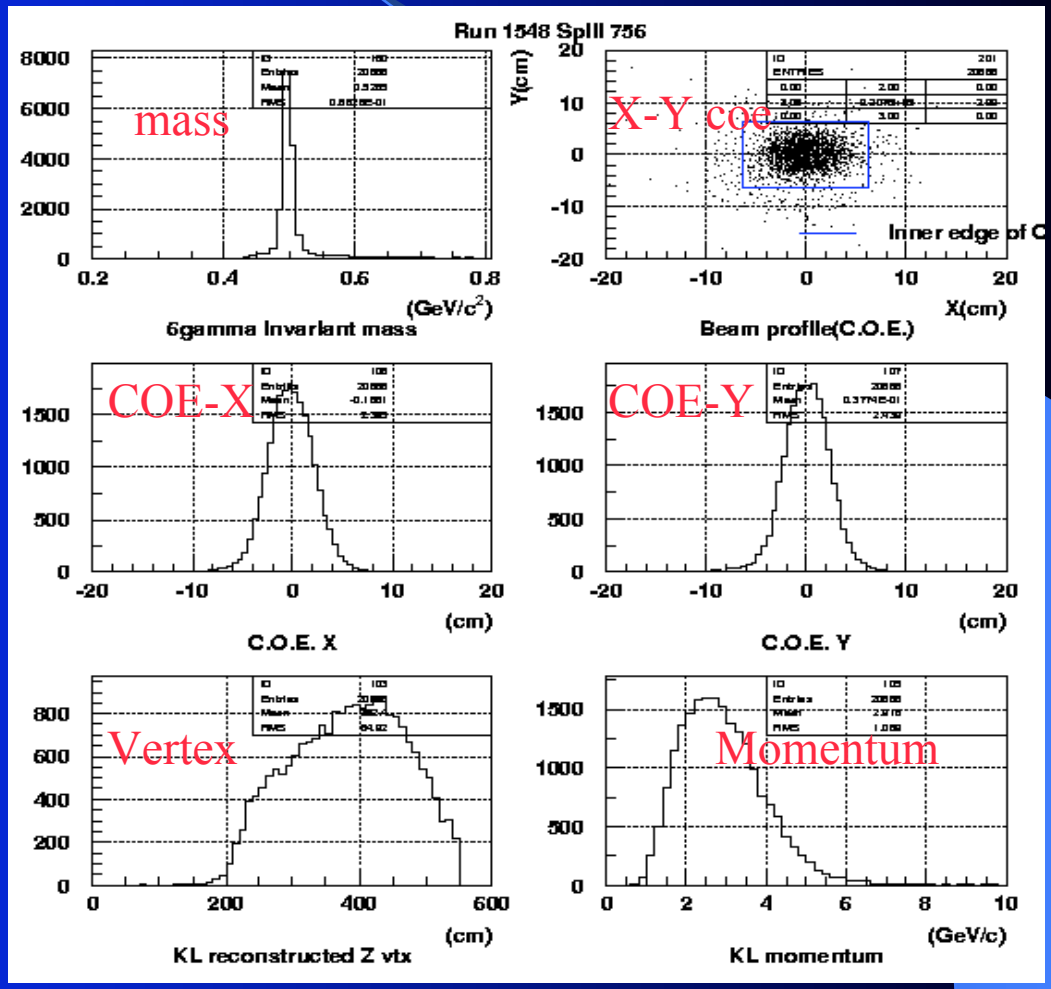
$5x10^5$ /spill

peak momentum : 2 GeV/c

DAQ live-time ratio : 75 %

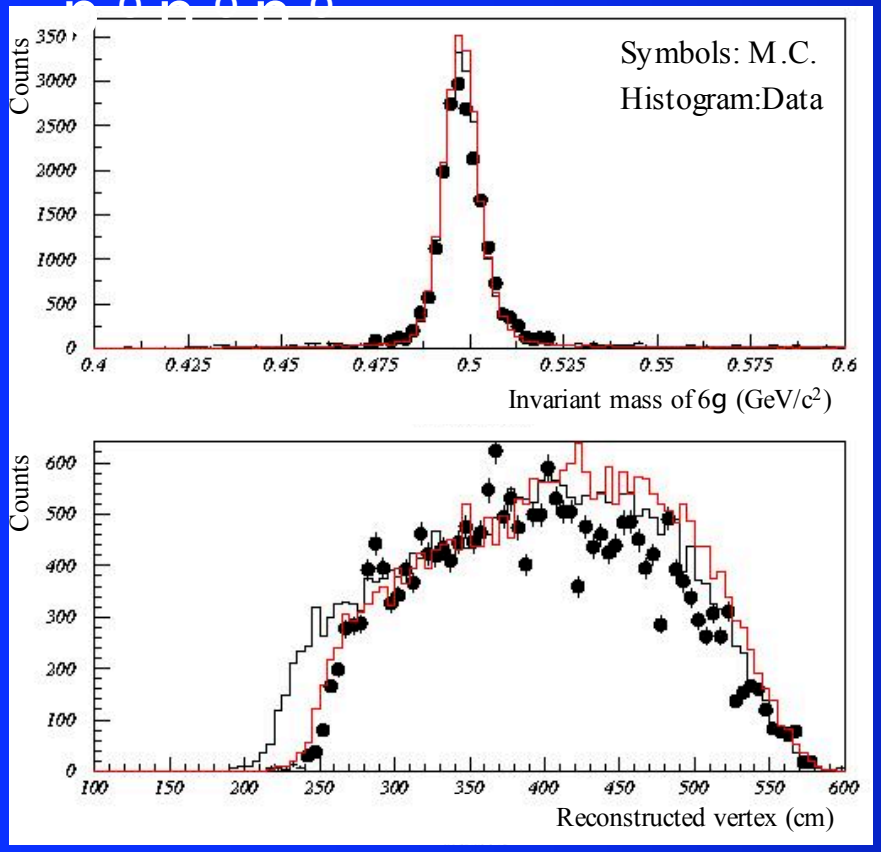
Vacuum pressure : $1X10^{-5}$ Pa

Online monitoring using $K_L \rightarrow p\,^0p\,^0p\,^0$ decay



Monitoring channels

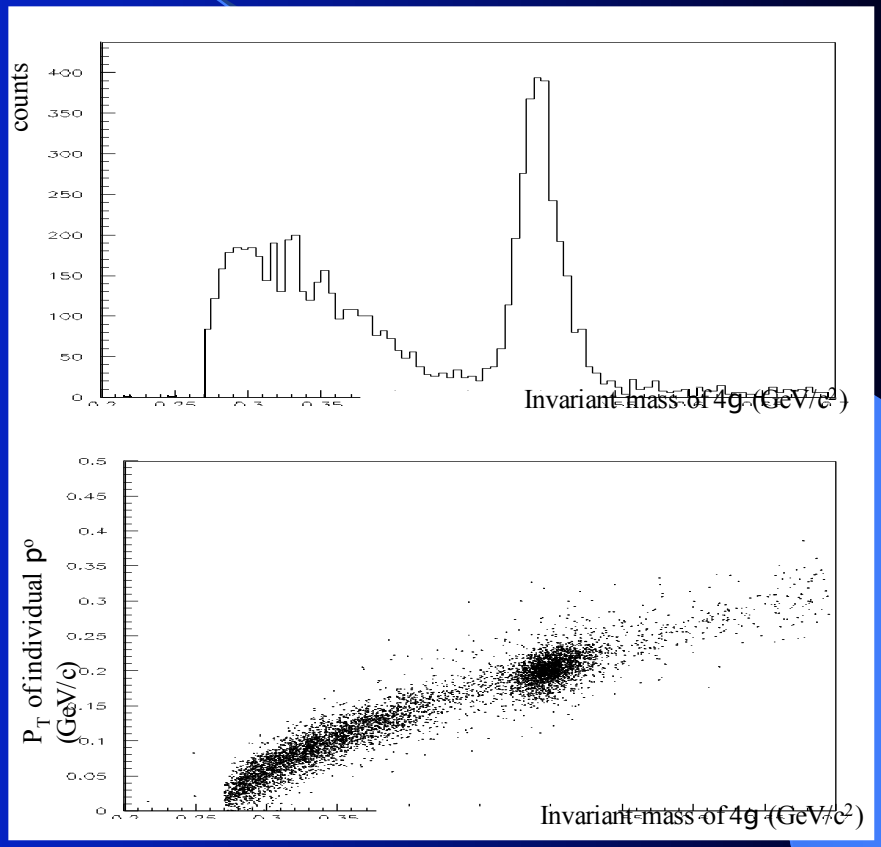
$K_L \rightarrow$ p°p°p°



Normalization of the K_L beam

Detailed study for accidental hits

$K_L \rightarrow p^o p^o$



Normalization of the K_L beam

To understand veto counters

Expected sensitivity

$S_{\pi\nu\nu}=(A_{3\pi}/A_{\pi\nu\nu}/Y_{3\pi})\cdot Br_{3\pi,}$

$A_{3\pi}/A_{\pi\nu\nu} \sim 1/20$

$Y_{3\pi} \sim 19(/\text{spill})\cdot 7.2\times10^{3}$ (spill/shift)$\cdot$(300-80-3×15)(shifts)

- 80 shifts: cooling water trouble(30)+tuning with shared beam(30)+tuning with full beam(20)
- 3×15 shifts: 3 special runs (air, short bunch, π^0 calibration)

$\sim 2.4\times10^{7}$

$Br_{3\pi} = 0.21$

$S_{\pi\nu\nu}\sim 4.4\times10^{-10}$ (without study for acceptance loss)

Summary

- E391a – the first dedicate experiment for the
  $K_L \rightarrow p^0 n n$ decay.
- Data taking has been done during 300 shifts from Feb. 2004 successfully.
- Analysis is being done aiming for the first result within this year.
- We are proposing Run II on the next year.
- Significant step for the precise measurement at the JPARC.